WHAT IS CLAIMED IS:

1. A method of compressing/extending a color reproducing space for transforming a color reproducing space of a first image input/output device into a color reproducing space of a second image input/output device, comprising:

a chroma compressing/extending step which compresses or extends chroma of a color gamut of the first image input/output device represent within the same hue plane in a uniform color space in said same hue plane;

a lightness correcting step for correcting lightness of the color gamut compressed or extended by the chroma compressing/extending step, said lightness correcting step not executing correction of the lightness when a chroma value is 0, correcting a highest chroma point having a maximal chroma value of said compressed or extended color gamut to a specified point in the color gamut represented in said same hue plane of the color reproducing space of said second image input/output device when said chroma value is the maximal chroma value and correcting the lightness such that a correction amount of the lightness changes in a non-linear manner as the chroma value becomes higher when the chroma value is within a range of from more than 0 to less than said maximal chroma value; and

a lightness compressing/extending step of compressing or extending the color gamut which has been processed by said

chroma compressing/extending step and said lightness correcting step into within the color gamut of said second image input/output device in said same hue plane.

2. The method of compressing/extending the color reproducing space according to claim 1, further comprising:

a color gamut correcting step of correcting an edge form of the color gamut of said second image input/output device in accordance with an edge form of the color gamut of said first image input/output device, before compression or extension to the color reproducing space of said first image input/output device using said method of compressing/extending the color reproducing space is performed.

3. The method of compressing/extending the color reproducing space according to claim 1, further comprising:

a non-linear correcting step which corrects a non-linear portion of an edge form of the color gamut of said first image input/output device or said second image input/output device in a linear manner, before compression or extension into the color reproducing space of said first image input/output device using said method of compressing/extending the color reproducing space is performed.

4. The method of compressing/extending the color reproducing space according to claim 1, wherein, when the color reproducing space is compressed or extended using the method of compressing/extending said color reproducing space, a adjusting parameter of adjusting at least one of a hue, a chroma range and a lightness region for correcting the color reproducing space is provided to adjust at least one of a corresponding hue, a corresponding chroma range and a corresponding lightness region in the color reproducing space to transform into by compression or extension.

5. The method of compressing/extending the color reproducing space according to claim 4, wherein the adjusting parameter which adjusts at least one of said hue, chroma range and lightness region is an adjusting parameter related to at least one of primary colors.

6. The method of compressing/extending the color reproducing space according to claim 5, wherein a color gamut correction parameter to be calculated for correcting the color reproducing space determines a color gamut correction amount to be added to data of a hue of interest by performing an interpolation in accordance with a position of said hue of interest from said adjusting parameter of primary colors located on both sides of

said hue of interest on the uniform color space.

7. The method of compressing/extending the color reproducing space according to claim 2, further comprising:

before said method of compressing/extending the color reproducing space in the color reproducing space of said first image input/output device is performed, a white color/black color adjusting step which, when a white point or black point within the color reproducing space of said first image input/output device or said second image input/output device is not located on a lightness axis on the uniform color space, corrects the white point or a range in the neighborhood thereof or the black point or a range in the neighborhood thereof to correct the white point or the black point to be on said lightness axis;

a lightness region adjusting step for allowing a lightness region of the color reproducing space of said first image input/output device to be set by the position of points of white color and black color which have been adjusted to be on the lightness axis and a lightness region of the color reproducing space of said second image input/output device to coincide with each other by means of enlargement or contraction;

a color gamut correction parameter calculating step which calculates a color gamut correction parameter in accordance

with the color gamut the edge form of which is corrected and the resultant corrected edge form of which is set by said color gamut correcting step or said non-linear correcting step; and

a color reproducing space calculating step which determines a corrected color gamut for each hue using the color gamut correction parameter calculated in said color gamut correction parameter calculating step and allows the thus determined, corrected color gamut to be the color reproducing space of said first image input/output device which is to be subjected to compression or extension of the color reproducing space, or the color reproducing space of said second image input/output device to compress or extend the color reproducing space into.

8. The method of compressing/extending the color reproducing space according to claim 2 or 3,

wherein said color gamut correcting step corrects the edge form of the color gamut of said second image input/output device by allowing a hue of at least one of primary colors in the color gamut of said second image input/output device to coincide with a hue of at least one of the primary colors in the color gamut of said first image input/output device, and

wherein, when a lightness change relative to a chroma change of the edge form on the color gamut of said first image

input/output device or said second image input/output device is non-linear, said non-linear correcting step corrects the lightness change relative to the chroma change of the edge form on said color gamut in a linear manner within the same hue plane in the uniform color space.

9. The method of compressing/extending the color reproducing space according to claim 1,

wherein said lightness compressing/extending step performs a non-linear compression or extension such that a ratio of compression or extension is larger in the neighborhood of an edge of the color gamut to be compressed or extended while the ratio of compression or extension is smaller as a point in the color gamut to be compressed or extended is apart from the neighborhood of the edge.

10. The method of compressing/extending the color reproducing space according to claim 9,

wherein, when compression or extension is performed keeping the chroma value to be constant in the color gamut to be compressed or extended, a ratio of compression or extension is fixed as 0 at a middle point having a middle lightness value between a maximal lightness value and a minimal lightness value at a specified chroma value and a ratio of compression or

extension is larger as a point is apart from the middle point, and

wherein, when the ratio of said compression or extension surpasses a maximal compression or extension ratio which have been previously set, a point to which the middle point is moved by compressing or extending the middle point is moved such that the point is contained within said maximal compression ratio and said maximal extension ratio.

11. The method of compressing/extending the color reproducing space according to claim 10,

wherein, when said compression or extension ratio still surpasses the maximal compression or extension ratio which has been previously set even after said middle point is moved by transformation, a point having a middle value between the maximal lightness value and the minimal lightness value at the same chroma value in the color gamut of said second image input/output device as that of said middle point in the color gamut of said first image input/output device is set as a fixed point and then compression or extension is performed such that the compression/extension ratio is 0 at the fixed point, increases as a point is apart from the fixed point and becomes said maximal compression ratio or said maximal extension ratio at the maximal lightness value and the minimal lightness value

and, thereafter, compression or extension is performed in a linear manner.

12. The method of compressing/extending the color reproducing space according to claim 1, further comprising the steps of:

predetermining a common region highest chroma point having a maximal chroma value within the same hue plane in a common region of color gamuts of said first image input/output device and said second image input/output device, before said chroma compressing/extending step is performed;

performing compression or extension in which the chroma value at the highest chroma point of the color gamut to be compressed or extended becomes the chroma value of said common region maximal chroma point with respect to the color gamut in said chroma compressing/extending step; thereafter,

performing the correction of lightness value which allows the highest chroma point of the color gamut in which compression or extension of the chroma has been transformed to coincide with said common region highest chroma point, in said lightness correcting step; and thereafter,

compressing or extending the color gamut which has been corrected in said lightness correcting step to transform it into the common region of the color gamut of said first image input/output device and said second image input/output device

thereby performing the method of compressing/extending the color reproducing space for each hue plane, in said lightness compressing/extending step.

13. The method of compressing/extending the color reproducing space according to claim 4, further comprising the steps of:

determining a chroma value C_1 on an edge of the color gamut of said second image input/output device having a same lightness value as that of said highest chroma point of the color gamut of said first image input/output device in the same hue plane on the uniform color space, before said chroma compressing/extending step is performed;

determining a chroma value C_2 of a common region highest chroma point having the maximal chroma value in the common region of the color gamuts of said first image input/output device and said second image input/output device in said same hue plane;

determining a chroma value C_3 of the highest chroma point of the color gamut of said second image input/output device in said same hue plane;

setting said adjusting parameter for adjusting a chroma range in which a range between said chroma value C_1 and said chroma value C_3 is a maximal adjustable range with said chroma value C_2 being in the center among the thus determined chroma

values;

determining a chroma value by interpolation from said chroma value C_1, chroma value C_2 and chroma value C_3 using the thus determined adjusting parameter, determining a point nearer to the lightness value of said highest chroma point on the edge of the color gamut of said second image input/output device having the thus determined chroma value and then setting the thus determined point as a corrected highest chroma point;

performing, in said chroma compressing/extending step, compression or extension in which the chroma value of the highest chroma point of the color gamut to be compressed or extended is the chroma value of said corrected highest chroma point on the color gamut of said first image input/output device; and thereafter,

performing, in said lightness correcting step, the lightness correction which allows the lightness value of the highest chroma point of the color gamut to coincide with the lightness value of said corrected highest chroma point on the color gamut in which chroma has been compressed or extended to be transformed.

14. The method of compressing/extending the color reproducing space according to claim 13, wherein said lightness compressing/extending step further comprises the stages of:

determining the color gamut belonging to both of the common region of color gamut of said first image input/output device and the color gamut of said second image input/output device in the same hue plane on the uniform color space and the color gamut in which lightness correction has been performed in said lightness correcting step as a coincidence emphasis region;

determining the color gamut obtained by replacing a portion of the edge within the color gamut of said second image input/output device with a curve which is present outside said coincidence emphasis region and inside the color gamut of said second image input/output device, curves in the color gamut of said second image input/output device in a non-linear manner as the chroma value becomes larger starting from 0 and reaches said corrected highest chroma point at the chroma value of said corrected highest chroma point as a color gamut emphasis region;

obtaining a corrected lightness region for each hue plane by interpolation from said adjusting parameter which adjust a set lightness region using the thus determined color gamut emphasis region and said coincidence emphasis region; and thereafter,

compressing or extending in said lightness compressing/extending step, the color gamut which has been corrected in said lightness correcting step and transformed into said corrected lightness region thereby performing the

method of compressing /extending the color reproducing space for each hue space.

14.
15. The method of compressing/extending the color reproducing space according to claim 1, wherein a transformation of compression or extension to be performed in said chroma compressing/extending step or said lightness compressing/extending step is a transformation represented in the following equation as a standardized value of from 0 to 1 before the transformation is denoted by X; a standardized value of from 0 to 1 after the transformation is denoted by F:

$$F = (k - 1) \cdot X^2 + X \qquad (1)$$

wherein k denotes compression/extension ratio.

15.
16. A method of compressing/extending a color reproducing space, comprising the step of:

before the color reproducing space is compressed or extended such that the color reproducing space of a first image input/output device is transformed into the color reproducing space of a second image input/output device having a different shape or size of the color reproducing space,

correcting an edge shape of a color gamut of said second image input/output device in accordance with an edge shape of a color gamut of said first image input/output device.

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17. A method of compressing/extending a color reproducing space comprising the step of:

before the color reproducing space is compressed or extended such that the color reproducing space of a first image input/output device is transformed into the color reproducing space of a second image input/output device having a different shape or size of the color reproducing space,

correcting a non-linear portion of an edge shape of a color gamut of said first image input/output device or said second image input/output device in a linear manner.

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18. A method of compressing/extending a color reproducing space, comprising the steps of:

when the color reproducing space is compressed or extended such that the color reproducing space of a first image input/output device is transformed into the color reproducing space of a second image input/output device having a different shape or size of the color reproducing space,

providing an adjusting parameter of adjusting at least one of a hue, a chroma range and a lightness region for the purpose of adjusting the color reproducing space; and then

adjusting at least one of corresponding a hue, the chroma range and the lightness region of the color reproducing space to transform into by compression or extension.

19. A method of compressing/extending a color reproducing space in which, when the color reproducing space is compressed or extended such that the color reproducing space of a first image input/output device is transformed into the color reproducing space of a second image input/output device having a different shape or size of the color reproducing space, comprising the step of:

preliminarily determining a coincidence emphasis region in which magnitude relationship of lightness values or chroma values before and after such compression or extension is maintained and image gradations or color appearances before and after such compression or extension coincide with each other, even if the color gamut of said first image input/output device is compressed or extended in the same hue plane, and a color gamut emphasis region that contains said coincidence emphasis region, is contained in the color gamut of said second image input/output device and has the color gamut to be outputted by said second image output/input device being larger than said coincidence emphasis region;

determining the color gamut by interpolation using the thus determined coincidence emphasis region and color gamut emphasis region in accordance with intensities of emphases thereof as a color gamut to transform into; and whereby

performing compression or extension.

19.

20. A color reproducing method for producing a transformation table for use in a plurality of image input/output devices having different color gamuts, comprising:

a first step of producing a database A representing transformation that uses input image data to a first image input/output device as an input, transforms the input into a reproducing color of said first image input/output device and uses the thus transformed reproducing color as an output;

a second step of producing a database B representing transformation that uses input image data to a second image input/output device as an input, transforms the input into a reproducing color of said second image input/output device and uses the thus transformed reproducing color as an output;

a third step of producing a database AB by transforming a color gamut of the first image input/output device represented by said database A into within a color gamut of the second image input/output device represented by said database B such that gradation is preserved;

a fourth step of producing a database BA by transforming a color gamut of the second image input/output device represented by said database B into within a color gamut of the first image input/output device represented by said database A such that gradation is preserved;

a fifth step of producing a database BA^{-1} in said database

B by determining inverse transformation of the transformation from said database B to said database A by an inverse operation and then providing resultant inverse transformation to the color gamut of the first image input/output device represented by said database A; and

a sixth step of producing a color reproduction target database N for performing transformation from said database A to said database B by mixing color gamuts with respect to said second image input/output device represented by said database AB said database BA^{-1} in a linear manner.

21. The color reproducing method according to claim 20, wherein,

when said database BA^{-1} is produced in said fifth step, by taking the output of the database A determined in said first step as the output of said database BA, an input of the database BA with respect to said output is determined from transformation in said fourth step by an inverse operation;

an output of the database B relative to the database BA is determined; and

the input of said database A and said database BA^{-1} is produced by allowing the input of said database A to correspond to the output of said database B.

22. The color reproducing method according to claim 20, wherein said each transformation includes light source transformation and light range adjustment.

23. The color reproducing method according to claim 20, wherein a transformation table ab for transformation from the color gamut of said first image input/output device to the color gamut of said second image input/output device is produced from said color reproduction target database N.

24. The color reproducing method according to claim 23, wherein a transformation table ab^{-1} for transformation from the color gamut of said second image input/output device to the color gamut of said first image input/output device is produced from said transformation table ab by the inverse operation.

25. The color reproducing method according to claim 20, wherein said each inverse operation is executed by an iterative search method.

26. A color reproducing device for producing a transformation table for use in a plurality of image input/output devices having different color gamut, comprising:

a device for producing a database A representing

transformation in which input image data to a first image input/output device is taken as an input, the input is transformed into a reproducing color of said first image input/output device and a consequence of such transformation is taken as an output;

a device for producing a database B representing transformation which takes an input image data to a second image input/output device as an input, transforms the input into a reproducing color of said first image input/output device and takes a consequence of such transformation as an output;

a device for producing a database AB by transforming the color gamut of the first image input/output device represented by said database A into within the color gamut of the second image input/output device represented by said database B such that the initial gradation is preserved;

a device for producing a database BA by transforming the color gamut of the second image input/output device represented by said database B into inside the color gamut of the first image input/output device represented by said database A such that the initial gradation is preserved;

a device for producing a database BA^{-1} in said database B by determining an inverse transformation of the transformation from said database B into said database A by an inverse operation and then providing the thus determined

inverse transformation to the color gamut of the first image input/output device represented by said database A; and

a device for producing a color reproduction target database N for transforming said database A into said database B by mixing the color gamut with respect to said second image input/output device represented by said database AB and said database BA^{-1}.

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